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IRRIGATING THE PRAIRIE HOME GARDEN

by

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Experimental Farm, Swift Current, Sask.

SPRINKLERS IN OPERATION

CANADA DEPARTMENT OF AGRICULTURE
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Introduction

A highly productive vegetable garden, together with a substantial windbreak, ornamental shrubbery, and lawn areas, is of inestimable value in maintaining the health and general well-being of the farm family. However, this objective is not always easy to attain. In drier areas where natural precipitation alone is relied upon results have sometimes been disappointing. The benefits derived from irrigating the garden on the other hand can far outweigh the labor and expense involved.

This bulletin deals with the furrow and sprinkler methods of irrigating the home garden and related topics.

Water Supply

The water supply is of first importance in irrigation. Not only must there be sufficient water to permit adequate irrigation throughout the summer months, but the supply must also be relatively free from alkali salts so that the soil does not become unproductive through increased alkalinity. If there is doubt about the suitability of the water it should be analyzed.

There are several sources of water supply. Underground water, if in sufficient quantity, can be pumped from a well. Surface supplies, such as lakes and streams, are sometimes available. Water may be supplied from storage reservoirs such as dams and dugouts where surface runoff is impounded. The most common water supply on the prairies for garden irrigation is the farm dugout.

It takes more water than is usually estimated to irrigate a specified area of land. A dugout 150 by 70 by 14 feet deep will supply enough water to irrigate about one acre for one season. An irrigated garden of this size will yield a surprising quantity of vegetables and a considerable amount of time will be required to keep the weeds down. A farmer who has enough water to irrigate more than one acre would be wise to use the surplus water for the growing of some specialized crop, such as forage seed, registered cereals, or an emergency fodder supply. If the water supply is limited, it should be concentrated on a small area to produce a high yielding garden and to beautify the home surroundings.

Location of the Garden

Since the irrigated garden likely will be near the water supply, the choice of location is limited. However, when alternative locations are possible certain factors should be considered. A garden close to the home will naturally receive more care and attention. Soil type and topography are important, especially when the garden is to be irrigated by the surface method. Irrigation will increase yields on any fertile soil, but a silty loam soil is ideal for the production of vegetables and, in addition, is easier to irrigate. Land that has a uniform slope of six inches or less in 100 feet, together with adequate

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surface drainage, is ideal. Steeper slopes and rolling topography can be irrigated but better results are obtained with less effort if the more gentle and uniform slopes are chosen. If the garden is to be irrigated by sprinkling, topography is of minor consequence.

Planning and Maintenance of the Garden

Fertility

The application of water alone does not necessarily mean that a high yielding garden will result. To get maximum value the water must be properly applied to a fertile soil. Because an irrigated garden yields more produce it may require the addition of fertilizers. Manure is one of the most satisfactory fertilizers for home gardens because it not only supplies the plants with nutrients but it adds organic matter and improves the structure of the soil. Well-rotted manure can be applied at rates up to 20 tons per acre. Manure alone, however, is not a fully balanced fertilizer and in order to secure maximum quality as well as high yields under irrigation it is advisable to add commercial fertilizer, particularly phosphate. Soil and climatic conditions vary widely across the prairies, and fertilizer treatments need to be varied accordingly to obtain the best results. For average conditions the most common practice is to apply ammonium phosphate (16-20-0) at the rate of 150 to 200 pounds per acre. Side dressing with fertilizer at one pound per 100 feet of row, when the rows are spaced two feet apart, is equivalent to approximately 220 pounds per acre.

Vegetable Varieties

The kinds and varieties grown will depend on family tastes and on the adaptability of the various kinds to local conditions. Table 1 lists varieties of vegetables recommended for southwestern Saskatchewan.

Table 1.—Vegetable Varieties for Southwestern Saskatchewan

Vegetable	Variety
ASPARAGUS	Mary Washington
BEANS	Green—Topcrop, Contender, Stringless Green Pod Wax—Round Pod Kidney Wax, Pencil Pod Black Wax
BEETS	Detroit Dark Red
CARROTS	Red Cored Chantenay, Nantes
CABBAGE	Early—Golden Acre, Jersey Wakefield Late—Penn State Ballhead, Danish Ballhead
CAULIFLOWER	Early Dwarf Erfurt, Early Snowball
CORN	Standard—Improved Golden Gem Hybrid—J-6 Cross, Sugar Prince, Seneca 60, Spancross
CELERY	Utah (Salt Lake)
CUCUMBERS	Table—Straight 8, Early Fortune Pickling—Early Russian, Mincu
LETTUCE	Leaf—Grand Rapids Head—New York No. 12, Great Lakes
ONIONS	Sets—White or Yellow Dutch Seed—Yellow Globe Danvers, Ebenzer, Yellow Globe type hybrids (trial) Transplants—Sweet Spanish (poor keeper), Yellow Globe Danvers (good keeper)
PARSNIPS	Short Thick

Vegetable	Variety
PEAS	Early—Little Marvel, Tiny Tim Main Crop—Lincoln (Homesteader), Selkirk
PUMPKIN	Sugar (New England Pie), Early Cheyenne Bush
RADISH	Round—Cherry Belle, Comet, Saxa Long—White Icicle
RHUBARB	Macdonald
SQUASH	Buttercup, Green Hubbard, Golden Hubbard, Uconn.
SPINACH	Early—Bloomsdale Longstanding Late—New Zealand
SWISS CHARD	Lucullus
TOMATOES	Non-staking—Standard—Meteor, Early Chatham; Hybrid—Mustang Monarch Staking and Pruning—Harkness, Best-of-All
TURNIPS	Rutabaga—Laurentian
VEGETABLE MARROW	Long White Bush
POTATOES (dryland)	Red or Pink—Warba, Pontiac, Early Ohio White—Irish Cobbler, Canus
POTATOES (irrigation)	Late—Netted Gem, Columbia Russet

The location of the various vegetables in an irrigated garden requires careful planning. Planting the garden in sections according to the dates of maturity can simplify irrigation. Crops such as radish, lettuce, and greens which will be harvested early should be planted together. Cabbage, carrots, parsnips, and Swede turnips that are grown for winter storage may require water as late as September 15 and should be grouped at one side or end of the garden.

Seeding

Seeding of such vegetables as onions, carrots, parsnips, peas, lettuce, etc., is best done soon after May 1. Corn, beans, and vine crops are best delayed until May 15 or later, depending on the season. The setting out of well-hardened cabbage and cauliflower plants can be done after May 15; but tomatoes, eggplants, and peppers should not be set out until after June 1.

Spacing the Rows

Row spacing can be greatly reduced where irrigation is practised. Fifteen inches between rows for the smaller vegetables is satisfactory where water is abundant and is supplied regularly. In most cases the type of cultivation equipment, however, will govern the row spacing.

Thinning the Vegetables

Thinning vegetables is not nearly so important under irrigation as under dryland conditions. Irrigated root crops, such as carrots and beets, will become overlarge and coarse where heavy thinning is practised. For this reason these crops are generally seeded thinly and are not subsequently thinned when irrigation is practised.

Weed Control

The success of the garden will depend in large measure on the control of weeds. Weeds are most satisfactorily controlled when they are young. The modern wheel hoes are valuable labor-saving devices and are highly recommended.

Insect Control

Control of insect pests is an important phase of all gardening efforts, and the early application of control measures is essential. Experience in previous years will usually indicate what the main insect problems are. Information on control may be secured from your nearest Experimental Farm or Insect Laboratory. The proper insecticides should be on hand for ready application as soon as the first damage is noted.

Land Preparation

In addition to the common tillage practices, levelling and floating are usually required, especially for surface irrigation. Levelling includes filling in low spots and cutting down high spots. This operation is accomplished with a scraper or "tumblebug" and is usually completed during the first year or two. Floating, on the other hand, is an annual operation. It consists of dragging a timber float or steel rail over the area and the customary practice is to float in two directions. The first stroke is made across the slope and the final one with the slope.

The importance of well-prepared land cannot be over-emphasized. An evenly graded surface not only facilitates the application of water, but since a more uniform distribution is obtained, yields can be expected to be higher. Levelling the land takes time but irrigation need not be delayed until the optimum condition is reached. Under irrigation troublesome spots will be easy to locate and the levelling may be completed over a period of years.

Irrigating by Surface Methods

Any practice that will add moisture to the soil in the spring without causing erosion of the land should be encouraged. Such practices include the use of snow traps and spring flooding. Flooding the garden during the growing season is not recommended, however, because water in contact with the plants may have injurious effects. In addition, flooding is not an efficient means of applying water because a large proportion of the water is wasted. When the water supply is limited it is important to reduce the amount of waste water to a minimum by following carefully controlled irrigation practices.

Furrow Irrigation

The most common type of surface irrigation for gardens is the furrow method. Figure 1 shows the basic principles of this type of irrigation. The supply ditch runs across the slope at the upper end of the garden and the water is diverted to the furrows between the rows.

Figure 1 illustrates the simplest design for furrow irrigation. The lack of proper means of controlling the flow of water, however, limits its application to a few isolated cases where the topography is ideal. In most cases more accurate means of water control are required, the need for control increasing as the slope of the land increases. The water should be controlled so that it will be absorbed uniformly throughout the length of the row. This also reduces to a minimum soil erosion and waste water. Overall control is obtained by using various devices to regulate the main supply as well as to distribute it to the furrows.

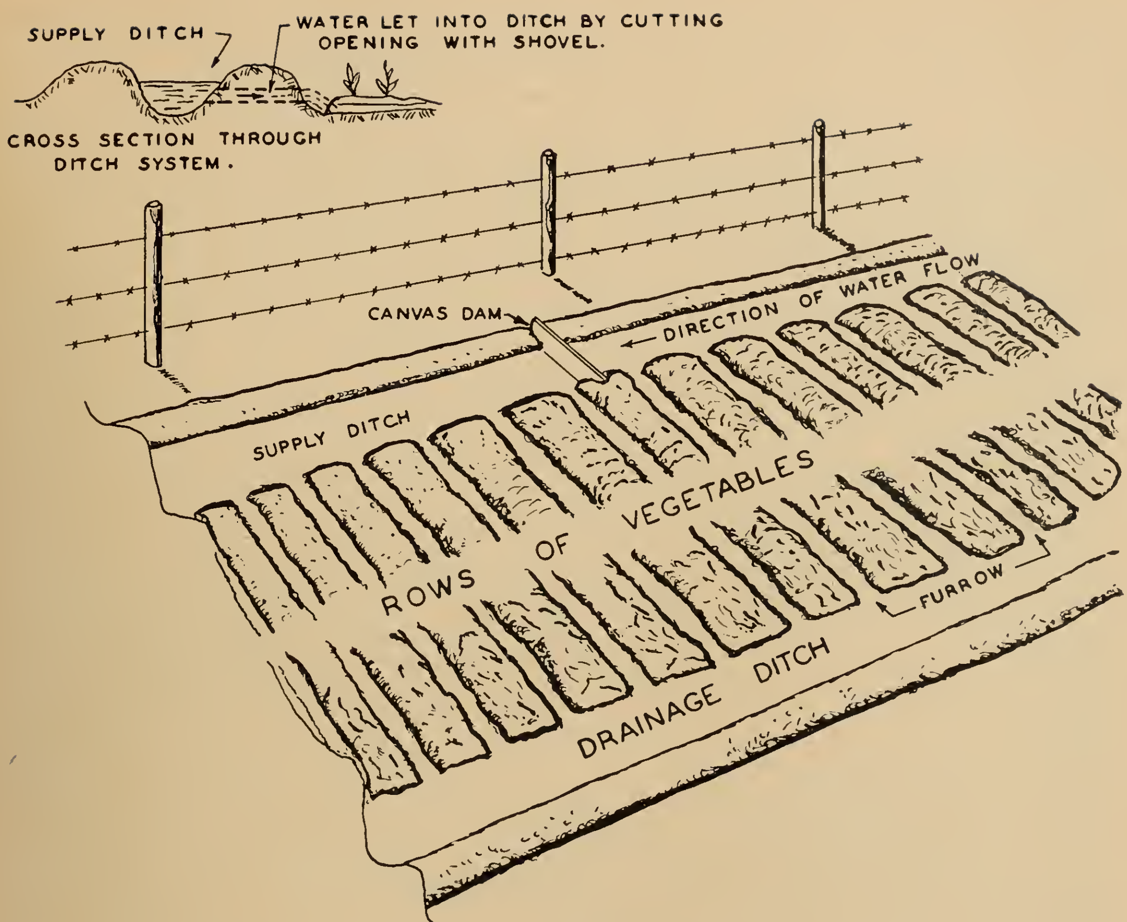


Figure 1—A simple form of garden furrow irrigation.
(Reproduced from *First Aid for the Irrigator*. U.S. Dept. of Agriculture.)

Figure 2—An adjustable canvas dam.

The main water supply can be regulated by using adjustable canvas dams and temporary dams or checks in the supply ditch. Additional control can be obtained by constructing a secondary ditch in which control devices are also used. Adjustable dams shown in Figures 2 and 3 are used to regulate the level of the water in the ditch by adjusting the opening in the "boot". This is accomplished by means of a drawstring. Excess water, if any, is bypassed through the opening. A series of dams may be necessary as shown in Figure 3 to maintain the water in the supply ditch high enough so that is can be diverted to the furrows.

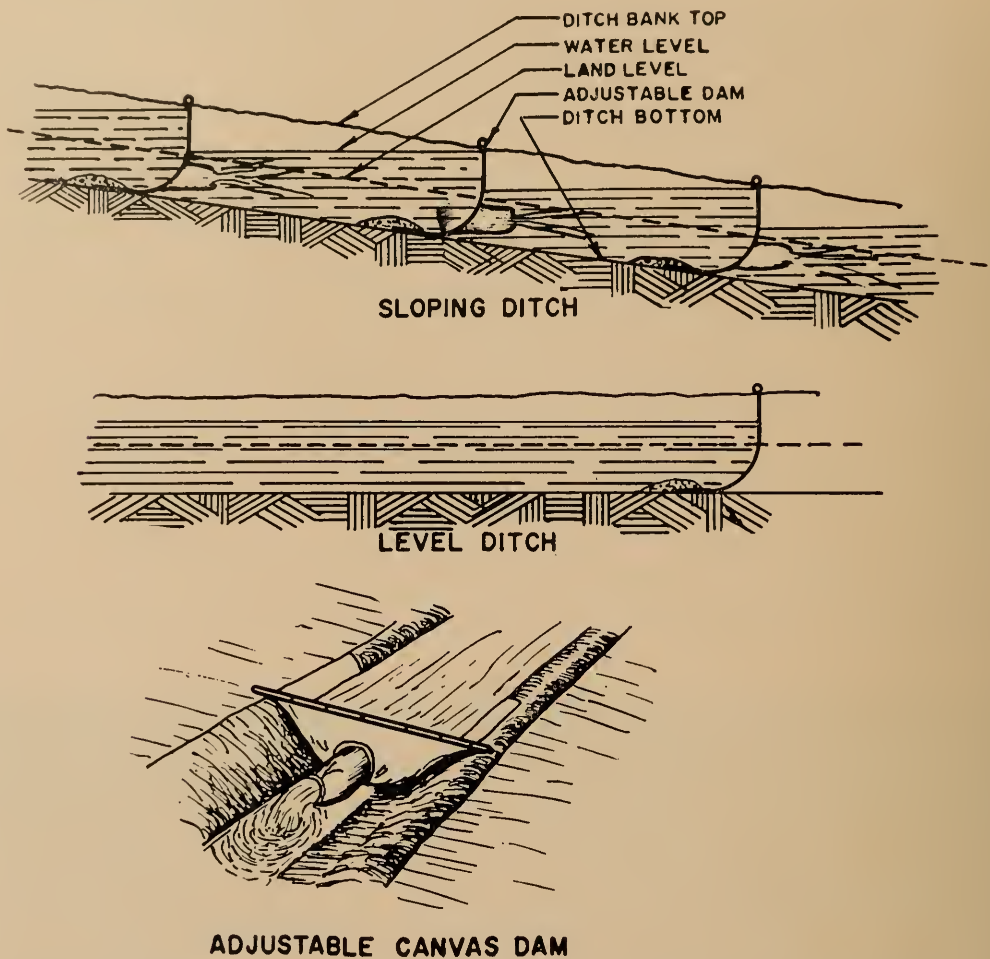


Figure 3—Adjustable canvas dams in sloping and level ditches.

Temporary checks or dams are illustrated in Figure 4. These are placed between the canvas dams to achieve a finer control of the water level. Pieces of scrap lumber or shingles can be used for this purpose.

A secondary head ditch is often used when difficulty is experienced in handling the water supply. This ditch, parallel with and adjacent to the supply ditch, gives the irrigator more time and opportunity to use regulating devices to control water flow. Figure 5 illustrates this type of set-up.

Turnouts, for diverting water from the supply ditch are illustrated in Figures 5 and 6. The baffle board at the outlet end prevents erosion of the opposite bank.

Numerous devices are available for distributing the flow of water to the furrows. These include miniature culverts, siphon tubes, and gated pipe. Small culverts, one or two inches in diameter, inserted in the ditch bank are much better than outlets cut in the bank with a shovel. These

culverts can be made from pieces of discarded pipe or hose, or four pieces of lath nailed together, and may handle one or two furrows. The soil should be well packed around them when they are being installed in the

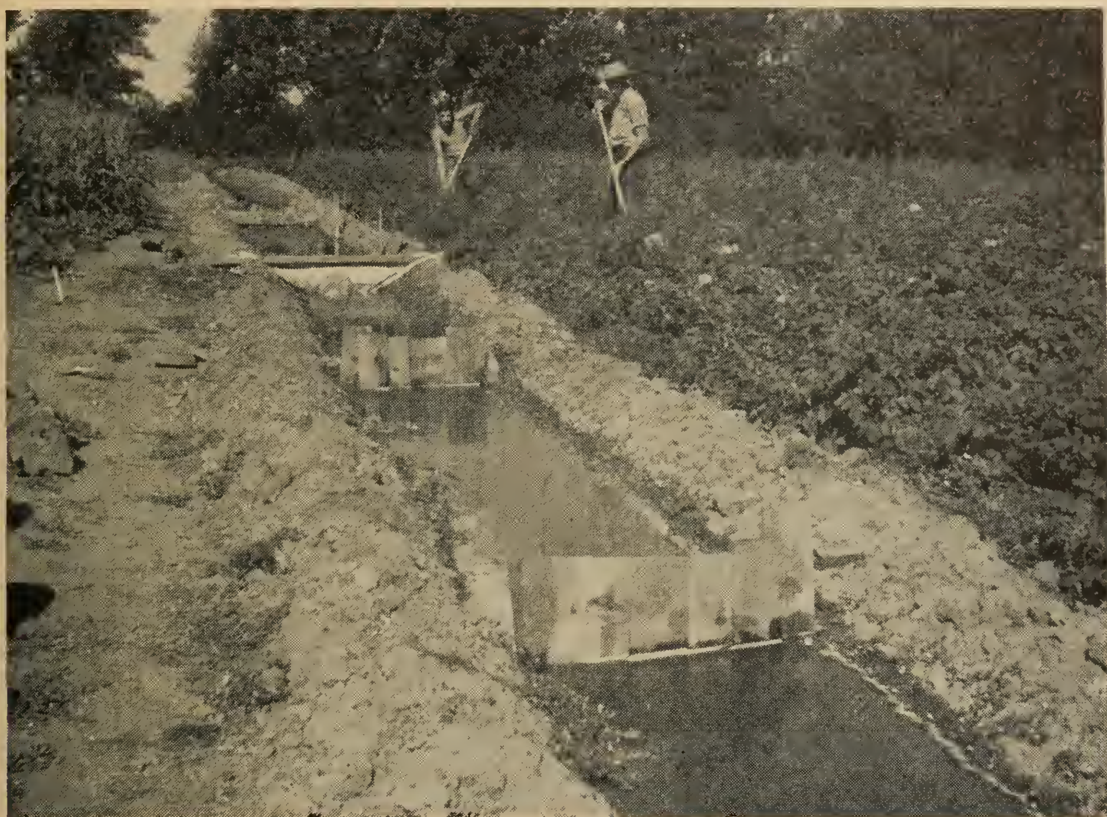


Figure 4—Shingles pushed into ditch to raise the water level slightly.

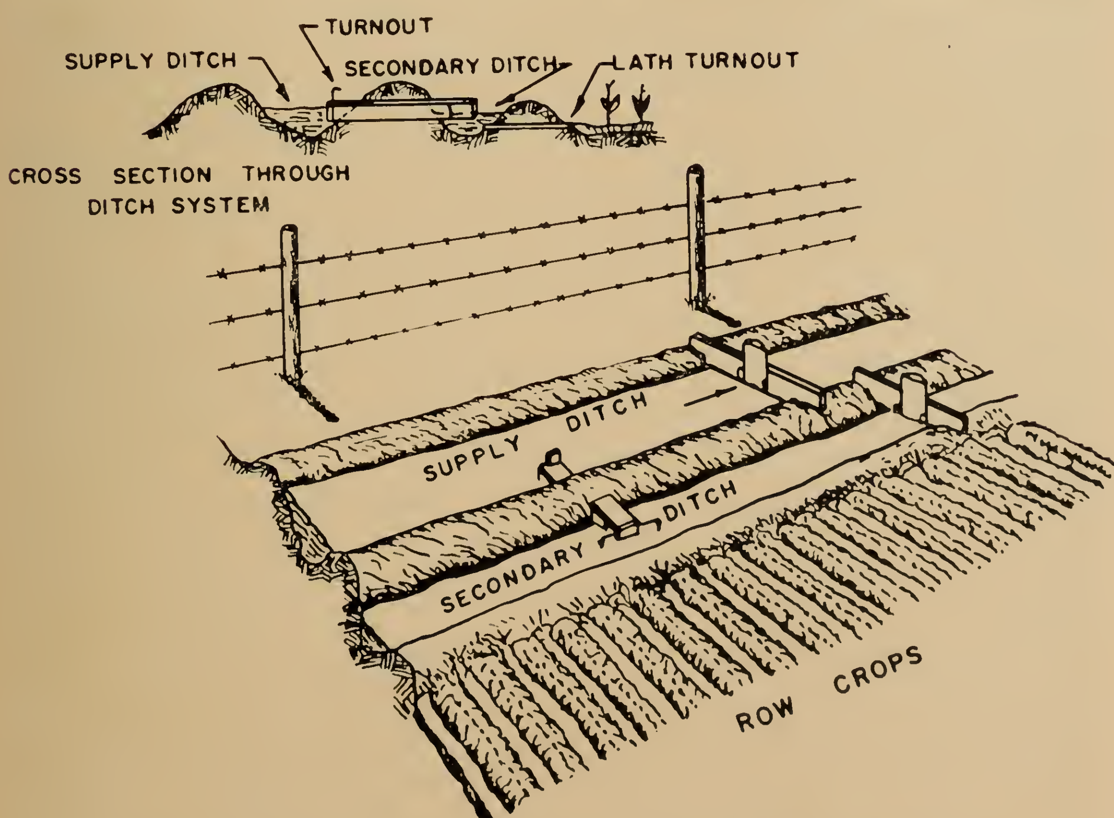


Figure 5—Furrow irrigation system using a secondary ditch.
(Reproduced from *First Aid to the Irrigator.* U.S. Dept. of Agriculture.)

ditch bank as shown in Figure 5. The culverts are in a fixed position. The amount of water flowing through them depends on the level of the water in the ditch. The water-level-regulating devices play a very important part when using culverts or outlets to distribute the flow.

Siphons shown in Figure 7 provide a better means of control because the amount of water flowing through each can be regulated by raising or lowering the outlet end. Devices for regulating the water level in the supply ditch are not so important when using siphons. It is only necessary to maintain the water in the ditch above land level. Siphons do not need to be placed in the bank and consequently less labor is required.

Gated pipe, shown in Figure 8 combines the functions of culverts and siphons and at the same time takes the place of the head ditch. The problems of regulating the total volume and adjusting the water level in the ditch are, therefore, completely overcome. Each hole in the pipe has a sliding gate. In this manner the stream to each furrow can be readily adjusted as shown in Figure 9.

Gated pipe may be inserted through the bank of the supply ditch, or it may be connected directly to a pump.

The importance of being able to control the size of stream can be visualized in Figures 10 and 11. Figure 10 illustrates poor irrigation caused by inadequate adjustment of stream size. The stream is too large, causing the water to flow so fast that it has not sufficient time to soak into the soil. Figure 11 shows good control of stream size in that the soil is moistened from furrow to furrow.

Figure 6—Turnouts delivering water to the secondary ditch.

Figure 7—Irrigating by siphon tubes.

Figure 8—Irrigating by gated pipe.

Draining the Garden

Garden vegetables will not stand more than a few hours of ponded water. If excess water accumulates in isolated ponds throughout the garden, it must be removed. These flooded areas can usually be drained by digging temporary or emergency ditches. Every effort should be made to overcome the need for this emergency program by additional land levelling after harvest. A surplus of water at the lower end indicates a need for better water control or better

drainage. Inadequate water control may be caused by too large a volume of water in the supply ditch or too steep a slope. Reducing the grade by planting the rows at an angle to the slope will help if the slope is steep.

Figure 9—Adjusting the size of stream.

Figure 10—Stream flow too fast. Note ripples in water and dry soil between the furrows.

Figure 11—A satisfactory stream flow which permits adequate soaking of the soil between the furrows.

The Pump

When the water supply is below the level of the area to be irrigated, a pump is required to lift the water up to the land. Several types of pumps are available but the most common for irrigation purposes is the horizontal centrifugal shown in Figure 12. There are only a few instances where this pump is not used. For pumping small volumes against high pressures the

Figure 12—A small horizontal centrifugal pump and engine unit.

centrifugal is inefficient and if the pressure is too high no water will be delivered. If a pump is required to deliver quantities of 25 gallons per minute or less against pressures greater than 25 pounds per square inch, either a turbine or a jet pump is usually selected.

The horizontal centrifugal is limited to a practical suction lift of 15 to 20 feet. If the vertical distance from pump to low water level exceeds this limit, the deep-well type of pump is required. The choice in this case is usually between a vertical turbine and deep-well jet pump, with possibly a preference for the latter for the low flows and medium deep wells.

The several pump types available often make it difficult to select the type and size best suited to a particular application. The most satisfactory procedure when purchasing a pump is to supply the pump distributor with the following information: (1) type of water supply and quantity available, (2) vertical suction lift, that is, difference in elevation from low water level to pump, (3) length of suction line required, (4) vertical pressure lift, that is, difference in elevation from pump to high point of discharge line, (5) distance from pump to garden, (6) method of irrigation, (7) acreage to be irrigated and dimensions of the field and, (8) type of soil.

Presenting this information, preferably in sketch form, together with one of the designs illustrated in this bulletin, will aid the pump distributor to make a selection.

Note—To overcome the problem associated with priming, particularly when using a horizontal centrifugal pump, the purchase of a self-priming pump or the standard pump with priming attachment installed is highly recommended.

Hints on Pump Operation

Operating instructions are usually supplied with a new pump and the operator should follow these carefully. This discussion will, therefore, deal briefly with only the more important points.

1. Horizontal centrifugal pumps cannot pump air, therefore the suction line must be air-tight to ensure trouble-free operation. The safest practice is to keep the suction line as short and straight as possible with a minimum of joints and with the foot valve three feet below the surface. To avoid the development of air pockets, no part of the suction line should be higher than the pump inlet. A properly installed suction line not only helps to ensure continuous pump operation but, in addition, protects the pump from the risk of possible damage through heating if it runs empty as the result of losing its prime.

2. There is a tendency to have the pump packing too tight. An unduly tight packing increases power consumption and causes rapid wear of the shaft. The adjusting nuts should be uniformly drawn up until the leakage is reduced to a few drops per minute. A slight leakage is required to lubricate the packing and prevent scoring of the shaft.

3. Horizontal centrifugal pumps can handle muddy, trashy water. This feature is valuable when irrigating by the surface method but when sprinkling it loses some of its importance. Since sprinklers are subject to plugging, it is usually necessary to screen the water before it enters the foot valve. This is an excellent practice regardless of the irrigation method used because the impeller of the pump can also become clogged with solid objects such as sticks and stones. Since a clogged impeller reduces the pump capacity the safest practice is to have the foot valve screened at all times.

Time to Irrigate

The frequency of irrigation will depend upon the climate, soil type, and crops being grown. Wide variation in these factors makes it difficult to state definite rules. The time to irrigate is *before* the plants show signs of wilting. The soil must therefore be used as a guide, and since the soil surface will not supply the answers, a sample must be brought up from a depth of 6 to 8 inches.

There is usually sufficient moisture for good crop growth if the soil forms a firm ball when squeezed in the hand. If the soil will not form a ball, it indicates that it is time to irrigate. The exceptions to this are the very light and the heavy soils. Sandy soils do not form into balls readily even when wet. There is usually sufficient moisture if there is any tendency for this type of soil to stick together, while need for water may not be indicated until the soil tends to flow through the fingers. The heavier soils, on the other hand, will ribbon out between the thumb and forefinger when the moisture content is high. The need for water is indicated when a ribbon cannot be formed. Sandy soils should be tested every three or four days during hot dry weather.

The soil should be wetted thoroughly to a depth of 18 to 24 inches. On sandy soils this will mean an application of about 2 inches of water, on loams and silt loams about 3 inches, on clay loams and silty clay loams about 3½ inches, and on clay soils about 4 inches. Sandy soils do not hold so much water as clay soils, therefore they must be irrigated more often. If surplus water is available in the fall it is an excellent practice to plow the garden and irrigate at that time. In addition, this procedure improves greatly the tilth of heavy soils.

Irrigating by Sprinkling

Sprinkler irrigation has a place as a means of watering the vegetable garden and home surroundings, especially on land not suited to surface irrigation. Although sprinkler irrigation is generally more expensive there are certain advantages to be considered. Sprinklers can be used where it is impossible or difficult to irrigate by the surface methods. They permit better control and more economical use of water on the lighter soils. Economy in the use of water is particularly important when the water supply is limited. The operation of small sprinkler systems is comparatively simple.

Sprinkler irrigation is not new. The overhead permanent pipe and nozzle system commonly seen in truck gardens is an old established method. Since this type is an expensive installation, it is restricted to commercial enterprises. The advent of quick-coupling, light-weight aluminum pipe led to the development of the portable sprinkler system. Portability has reduced the cost and made it practical for farm use. The discussion will be limited to the portable system with rotary sprinklers.

The common double-nozzle field sprinklers that operate at a pressure of 35 to 40 pounds per square inch are the largest that should be considered for the prairie home garden. The smaller single-nozzle sprinklers that operate at 25 to 30 pounds per square inch are preferable since the lower pressure requirement reduces the operating cost and the size is more suitable for the small area. The two types mentioned can be purchased with either high or low angle nozzles. The high-angle nozzle is recommended for irrigating on the prairies because the higher trajectory increases the diameter of the wetted area. This allows a wider sprinkler spacing which also reduces the operating cost. The sprinkler used in designs 1 to 5 and which is illustrated in Figure 13 is the single-nozzle, high-angle type.

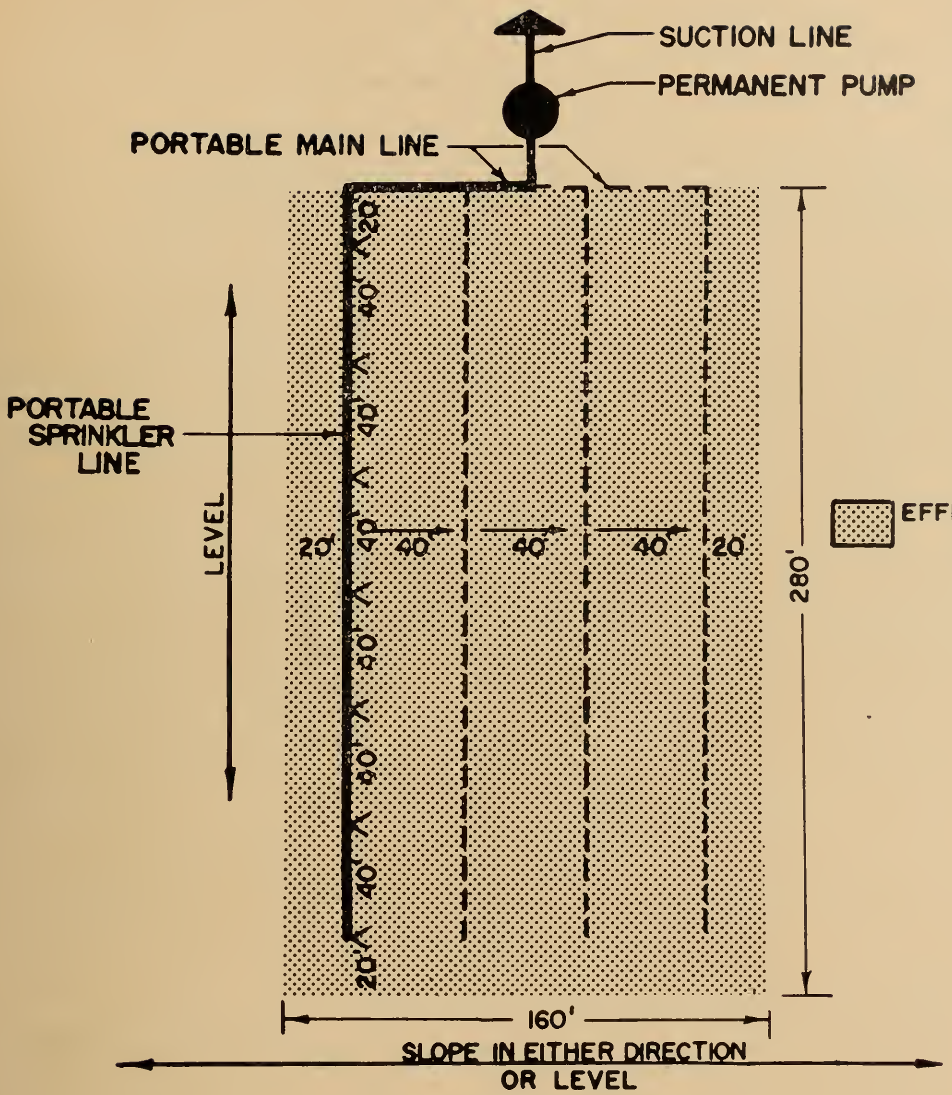
Figure 13—A garden sprinkler, riser, and pipe coupling.

Designing the System

A "package" unit is sold by some sprinkler irrigation firms as a standard system. The desirability of such a unit for prairie home gardens cannot be overlooked. It must also be realized, however, that the variability in types of soils and topography, sources of water supply, the size and shape of the garden, and its location in relation to the water supply means that no standard unit is suitable for all conditions.

The problem of designing a system for home garden use can be simplified if the farmer is prepared to accept the following restrictions in making his plans: (1) the area irrigated to be fixed at one acre, (2) the dimensions of the garden to be altered to suit the system, (3) the garden to be adjacent to the water supply, (4) deep wells to be excluded as a source of water supply, and (5) the time to irrigate once over to be four 10-hour days.

Designs 1, 2, and 3 are based on a rate of application suitable for the medium textured soils and are designed to accommodate the simpler variations in topography and water supply. Design 3 illustrates a pipe layout when a relatively long shoreline adjacent to the garden is available. These systems sprinkle at a rate of 0·42 inches per hour, a rate that, it is estimated, will be suitable for most installations. This is too fast for clay soils; therefore designs 4 and 5, which apply water at 0·25 inches per hour, are included for comparison. Design 2 is comparable to design 4, and design 3 comparable to design 5.



Design No. 1

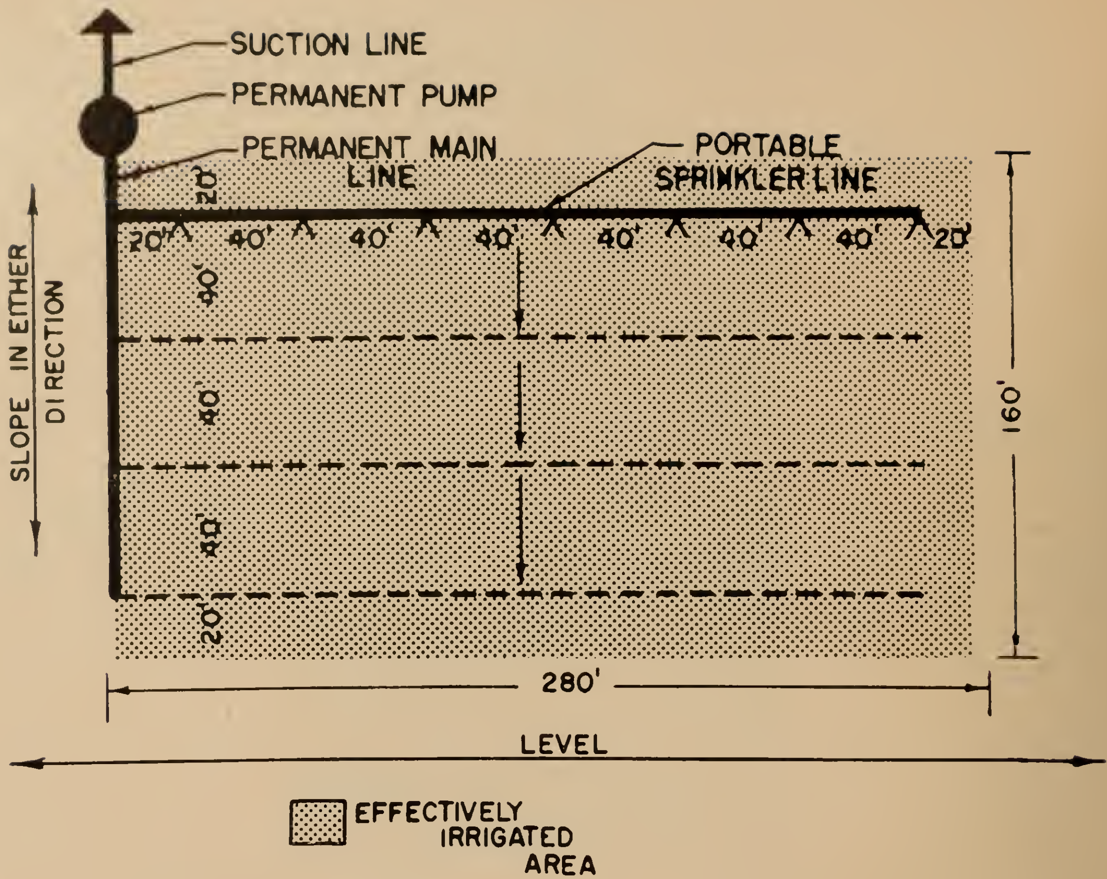
Water supply—Any source except deep well

Type of system—Permanent pump, portable main and sprinkler line

Sprinkler spacing—40 x 40 feet

List of materials—
- 1 Horizontal centrifugal pump (42 Imperial gallons per minute at a pressure of 45 pounds per sq. in.)
- 1 Engine (3 horse power)
- 1 2-in. x 35-ft, suction pipe and foot valve
- 1 2-in. pump to pipe adapter
- 17 2-in. x 20-ft. aluminum tubing
- 17 2-in. couplers
- 2 2-in. elbows
- 1 2-in. end plug
- 7 $\frac{7}{32}$-in. single-nozzle sprinklers
- 7 18-in. x $\frac{3}{4}$-in. risers, bushings and reducer couplers
- 10 1-in. pipe plugs
- 1 Pressure gauge
- 1 Tin of aluminum pipe "threadlube"

Approximate Cost $520.



Design No. 2

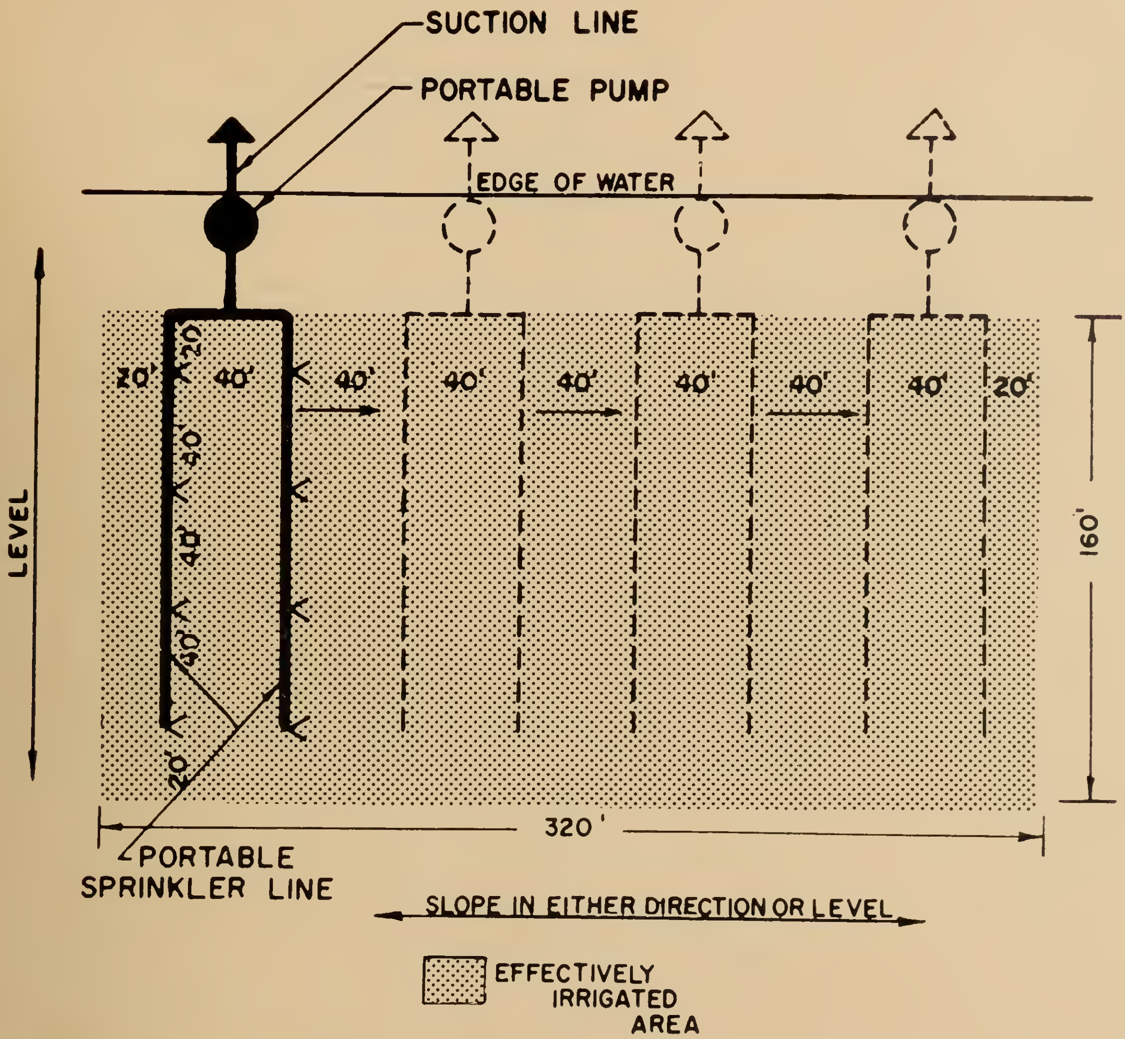
Water supply—Any source except deep well

Type of system—Permanent pump and main line, portable sprinkler line

Sprinkler spacing—40 x 40 feet

List of materials—
- 1 Horizontal centrifugal pump (42 Imperial gallons per minute at a pressure of 52 pounds per sq. in.)
- 1 Engine ($3\frac{1}{2}$ horse power)
- 1 2-in. x 35-ft. suction pipe and foot valve
- 1 2-in. pump to pipe adapter
- 20 2-in. x 20-ft. aluminum tubing
- 20 2-in. couplers
- 1 2-in. elbow
- 1 2-in. end plug
- 7 $\frac{7}{32}$-in. single-nozzle sprinklers
- 7 18-in. x $\frac{3}{4}$-in. risers, bushings, and reducer couplers
- 13 1-in. pipe plugs
- 1 Pressure gauge
- 1 Tin of aluminum pipe "threadlube"

Approximate cost $540.



Design No. 3

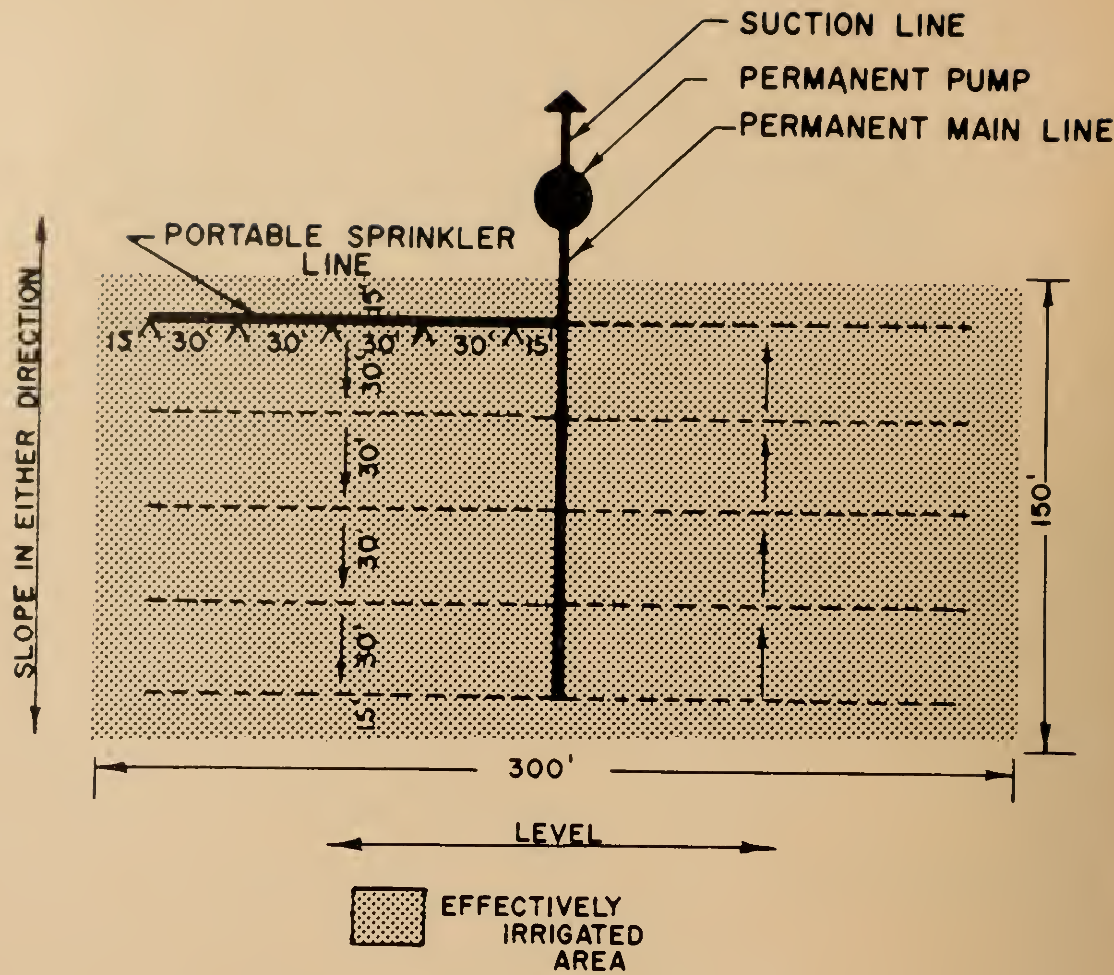
Water supply—Any source with a long shoreline

Type of system—Portable pump, main line and sprinkler line

Sprinkler spacing—40 x 40 feet

List of materials—
- 1 Horizontal centrifugal pump (48 Imperial gallons per minute at a pressure of 41 pounds per sq. in.)
- 1 Engine (3 horse power)
- 1 2-in. x 35-ft. suction pipe and foot valve
- 1 2-in. pump to pipe adapter
- 17 2-in. x 20-ft. aluminum tubing
- 17 2-in. couplers
- 1 2-in. field tee
- 2 2-in. elbows
- 2 2-in. end plugs
- 8 $\frac{7}{32}$-in. single-nozzle sprinklers
- 8 18-in. x $\frac{3}{4}$-in. risers, bushings, and reducer couplers
- 9 1-in. pipe plugs
- 1 Pressure gauge
- 1 Tin of aluminum pipe "threadlube"

Approximate cost $530.



Design No. 4

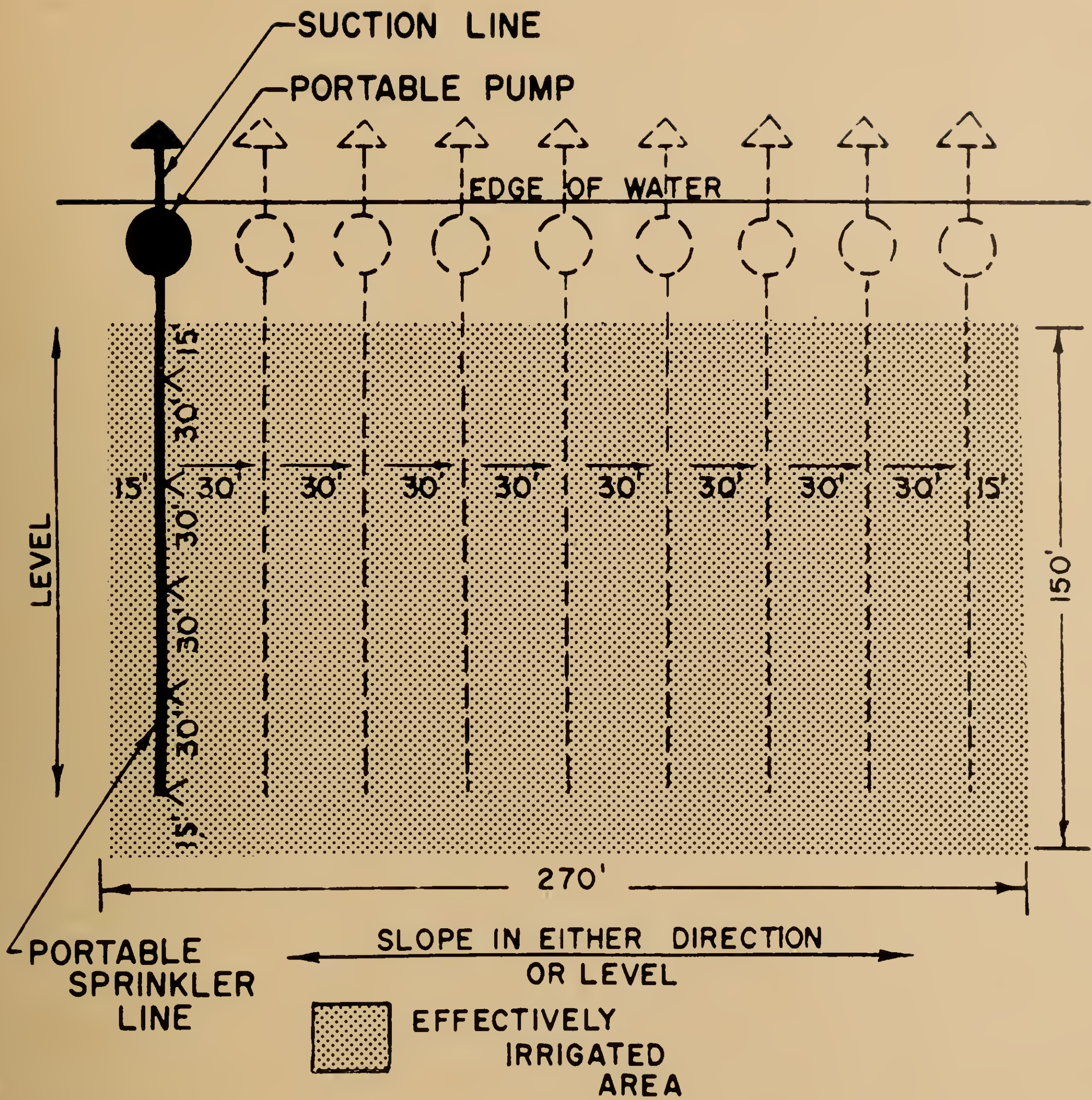
Water supply—Any source except deep well

Type of system—Permanent pump and main line, portable sprinkler line

Sprinkler spacing—30 x 30 feet

List of materials—
- 1 Pump (12 Imperial gallons per minute at a pressure of 37 pounds per sq. in.)
- 1 Engine (1 horse power)
- 1 2-in. x 35-ft. suction pipe and foot valve
- 1 2-in. pump to pipe adapter
- 10 2-in. x 30-ft. aluminum tubing (one length to be cut in half)
- 11 2-in. couplers
- 1 2-in. elbow
- 1 2-in. end plug
- 5 $\frac{9}{64}$-in. single-nozzle sprinklers
- 5 18-in. x $\frac{3}{4}$-in. risers, bushings and reducer couplers
- 5 1-in. pipe plugs
- 1 Pressure gauge
- 1 Tin of aluminum pipe "threadlube"

Approximate cost $345.



Design No. 5

Water supply—Any source with a long shoreline

Type of system—Portable pump, main line and sprinkler line

Sprinkler spacing—30 x 30 feet

List of materials—
- 1 Pump (12 Imperial gallons per minute at a pressure of 32 pounds per sq. in.)
- 1 Engine (1 horse power)
- 1 2-in. x 35-ft. suction pipe and foot valve
- 1 2-in. pump to pipe adapter
- 5 2-in. x 30-ft. aluminum tubing
- 5 2-in. couplers
- 1 2-in. end plug
- 5 $\frac{9}{64}$-in. single-nozzle sprinklers
- 5 18-in. x $\frac{3}{4}$-in. risers, bushings, and reducer couplers
- 1 Pressure gauge
- 1 Tin of aluminum pipe "threadlube"

Approximate cost $270.

Comments on Design

The systems shown in designs 1, 2, and 3 cost approximately $525 and will apply a net of three inches of water in four 10-hour days. Net application is based on 70 percent efficiency. The cost is high, on a per-acre basis, but it is assumed that a farmer would not wish to take more than four days to irrigate. The cost of the system can be reduced to approximately $300 by extending the time to nine or ten days as illustrated in designs 4 and 5. The cost on a per-acre basis using systems shown in designs 1, 2, and 3 can be reduced by irrigating larger acreages. This is accomplished by simply extending the time, if water and land adjacent to the supply are available. A case in point is design 3, in which the system could be moved along the water's edge until the first irrigated land needed water again. There is ample time to irrigate three acres (12 days) which would reduce the capital cost to about $185 per acre. Four days, to some, may seem too long to irrigate a one-acre garden. The time can be reduced to two days by designing a larger system which would cost about $850 or by irrigating night and day with designs 1, 2, or 3.

In sprinkling steep slopes certain precautions should be taken. Since the individual sprinkler discharge depends on the pressure at the sprinkler, it is not desirable to have the sprinkler lines running up or down the slope, because the higher sprinklers will be delivering less water than those near the bottom. When irrigating steep slopes, the pipe lines should be laid out so that the sprinkler lines are relatively level. An example of this change in pipe layout can be noted by comparing designs 1 and 2 or designs 4 and 5. The other alternative is to regulate the pressure by a valve at each sprinkler so that the spray from each is thrown the same distance.

One of the previously noted restrictions excluded deep wells as a water source. This simplified selecting the type of pump and calculating the horsepower requirement. The horizontal centrifugal pump is recommended in designs 1, 2, and 3 but not in designs 4 and 5. It cannot be recommended for the latter designs because of the small volume and high pressure requirement. There is a choice of several pumps for designs 4 and 5. The final selection will depend on a number of factors with possibly a preference for the horizontal turbine. For pumping from deep wells the choice lies between the vertical turbine and the ejector. (See section on pumps).

Sprinkler pipe is available in lengths of 20, 30, or 40 feet. Forty-foot lengths, however, are not recommended in designs 1, 2, and 3 although the sprinklers are spaced 40 feet apart. These long lengths are cumbersome to handle in a small garden, and in addition, lengths of 40 feet in the two-inch size are easily bent. A closer sprinkler spacing is required in designs 4 and 5 because of the lower rate of application. A 30- by 30-foot spacing is recommended because a more uniform water application is obtained than when spacing the sprinklers 20- by 40-feet. The latter spacing, however, is quite suitable and is recommended if pipes in the 20-foot lengths are more readily available or are on hand.

The sprinklers are attached to the pipe by means of risers. The height of riser will be determined by the crop grown. Risers should be high enough that the spray clears the plants. Risers 18 inches long are usually satisfactory for garden irrigation.

Operational Hints

1. Do not oil the sprinklers. They are water lubricated.
2. Use aluminum pipe thread compound on all aluminum pipe threads.
3. Flush the system before sprinkling by pumping a small volume through the pipes with the end plugs removed.
4. When starting the system run the pump slowly until water reaches the last sprinkler before bringing the pump up to speed.
5. Install a pressure gauge on each sprinkler line.
6. Check sprinklers from time to time to see that they are upright and rotating properly. Sprinklers should make about one revolution per minute.
7. If a sprinkler stops, check the following:
   (*a*) Plugged nozzles—frequent plugging of nozzles indicates the need for a screen at the foot valve or a more careful flushing of the system.
   (*b*) Pressure—a reduction in pressure may be caused by too slow a pump speed, partially plugged foot valve, leaking couplers or a break in the line.
   (*c*) The sprinkler arm should operate freely. A sticky arm usually indicates that it has been bent. The hammer can be bent back into shape if proper care is taken.
   (*d*) The tension of the spring.
   (*e*) The condition of the bearing washer. If black it has been oiled and should be replaced.
8. A leaking coupler may be caused by:
   (*a*) Condition of the end of the pipe. If out of round it should be reshaped.
   (*b*) Grass or stubble wedged between pipe and gasket.
   (*c*) Cracked or torn gaskets.
9. Observe any changes in wind speed and direction and set sprinkler lines accordingly.
10. Check the condition of pump, engine, pipes, gaskets, and sprinklers before storing the system and make any repairs required.

Summary

The home garden can be irrigated by either surface or sprinkler irrigation. The quality and quantity of the water supply should be carefully appraised before installing an irrigation system.

Factors to consider in addition to applying the water are location and fertility of the garden, planning for irrigation, land preparation, seeding, thinning, weeding and insect control.

The irrigator is advised to use a spade or auger to determine the time to irrigate, and cautioned to keep the soil moist during the growing season.

The main type of surface irrigation is the furrow method. The water may be delivered to the garden in four ways: (1) open ditch, (2) pump and open ditch, (3) pump and pipe, and (4) gated pipe.

The water may be distributed to the furrows by simply cutting openings in the ditch bank or by the use of small culverts, siphons, or gated pipe.

The garden area must be well drained to prevent injury to the plants from flooding.

Certain factors must be considered in purchasing a pump for irrigation purposes so that it will fit the individual conditions.

Sprinklers have a place in garden irrigation, especially on land not suited to the surface method. The design of sprinkler irrigation systems to suit various conditions is discussed.

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